Possible tectonic control on the observed asymmetry of drainage networks across the Ladakh batholith

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Major rivers, in tectonically active regions, have been used as passive markers of diffuse strain with the clear suggestion that it is considered unlikely that they migrate laterally under conditions of large scale compression. Longitudinal valleys that parallel major thrust fronts are a possible exception to this observation. In Ladakh, northern India, asymmetry is observed in the transverse drainage pattern of the Ladakh batholith. The batholith is, in part, sandwiched between two major longitudinal rivers – the Indus to the south and the Shyok to the north. The course of the Indus is potentially affected by the northward deformation of the Zanskar fold and thrust belt.

Large-scale quantitative measurements and analysis of the landscape morphometry have been utilised to document potential feedback between tectonic uplift and longitudinal river systems. Quantitative geomorphological analysis of different portions of the batholith that are considered to be effected by thrusting, and those that are not, reveal significant differences in the degree of asymmetry across the batholith. The Digital Elevation Model (DEM) has been combined with field observations and preliminary low temperature thermochronometry (apatite fission track and U-Th/He). The denudational history of the batholith is revealed through the thermochronometry results and linked to major tectonic events in the wider Himalaya. Combined the datasets have been used to document potential translation and to test the hypothesis that local drainage form is a function of the horizontal motion of a major longitudinal valley in response to tectonic activity.

The ^{26}Al ages of chondrules as the chemical records of the active proto-planetary disk

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Correlation of ages with chemical compositions

Recent studies of ^{26}Al age of chondrules from various classes of chondrites indicated that they formed at average of 2 million years (My) after CAIs (Ca, Al-rich Inclusions), by assuming the homogeneous ^{26}Al distribution in the early solar system. Our recent studies of 16 chondrules from ordinary chondrites suggested that the total span of their ages was at least 1 My. We further discovered that the olivine-rich (high Mg/Si) chondrules are older and generally depleted in volatiles (e.g. Mn and Na) than pyroxene-rich (low Mg/Si) ones. We considered the mechanism of the volatile enrichment (Si, Mn, Na) in younger chondrules as 1) evaporation of volatiles from older chondrules, 2) removal of older chondrules from the chondrule forming region, and 3) addition of evaporated volatiles to the precursor of younger chondrules.

Implication to the history of proto-planetary disk

The observed chondrules ages are comparable to the period of classical T-Tauri (CTT) stars. Recently, episodic (~hours) keV-range-X-ray flares were observed from many CTT stars with the energy 10^3-10^5 times larger than the solar flare. The flare is repeated during the CTT stage and produces shock waves (~200 km/s), so that the ^{26}Al ages of chondrules might record such an explosive magnetic activity of the proto-planetary disk. Evidence of volatility related chemical fractionation with chondrule ages implies that the episodic flares may cause high temperature gas/solid fractionation elsewhere in the proto-planetary disk. It has a significant implication to the cosmochemical fractionation among planetary materials.

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